PROJECTILE FIRING BARREL

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TECHNICAL FIELD

The present invention relates generally to inflatable occupant restraint systems for use in motor vehicles, and more particularly to a gas generator in such a system utilizing a pyrotechnically driven projectile for releasing inflation gas from a stored gas vessel for inflation of an airbag.

BACKGROUND OF THE INVENTION

Inflatable safety restraint devices have become standard equipment on many new automobiles. Many designs have developed over the years, incorporating a wide variety of components. In a typical design, an inflatable airbag or cushion is mounted in a folded state, and inflated to protect a vehicle occupant in response to an activation signal from an onboard electrical activation system. The gas generator or inflator commonly associated with the system supplies an inflation gas for filling the airbag. The inflator is typically the heaviest and most complex component in such a system. A reduction in weight and manufacturing complexity are often desirable in the automotive industry, and thus it is desirable to reduce the number and complexity of inflator parts.

Various inflator designs and methods have been utilized, for example, many systems employ an ignitable gas generant or pyrotechnic that combusts to rapidly supply inflation gases that are directed into the airbag. Many effective designs are known, however, the inherently hot gases associated with pyrotechnics and particulate material resulting from combustion thereof can present unique concerns. The hot combustion gases must, for example, be cooled to prevent damage to the system materials, particularly the airbag, and also to mitigate potential harm to vehicle occupants. Combustion of the gas generant can create noxious smoke and therefore, the gas generant

compositions must be tailored to produce levels in compliance with regulatory and industry standards.

Other systems utilize a stored, pressurized gas in a canister or bottle that is released by rupturing a seal, then directed into the airbag. Advantages of the stored gas systems include lower temperatures of the inflation gases, and the lack of particulates. However, developing a fast-response, reliable system for controllably releasing the pressurized gas has proven difficult. One approach has been to combine a pyrotechnically driven projectile for rupturing the seal on the pressurized gas canister. In such a system, an onboard activation system ignites gas generants to provide an actuation gas for driving the projectile into the subject seal. These systems provide an effective means for quickly and reliably releasing the stored gas, however, relatively high velocities are required of the projectile, and after the projectile has performed its intended function, deflection and bouncing of the projectile in the apparatus may, for example, irreparably damage the associated equipment.

A further challenge to designers relates to igniting the pyrotechnic charge used to drive the projectile. Where the successful deployment of the airbag depends upon accurately and reliably igniting a relatively small pyrotechnic charge to drive a projectile, it is desirable to design a system providing reliable, repeatable performance.

SUMMARY OF THE INVENTION

The present invention provides a gas generator for an inflatable occupant protection system in a motor vehicle. The gas generator preferably includes a gas canister having pressurized gas stored therein and a rupturable seal at an end. An elongate projectile firing barrel having a touch hole, preferably formed in a side thereof, is also provided, and includes a quantity of propellant positioned therein. A projectile is positioned in the barrel and movable therein upon an ignition of the propellant. Ignition of the propellant drives the projectile into the rupturable seal, allowing pressurized gas to exit the canister for inflation of an airbag.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a partially sectioned side view of an inflator according to a preferred embodiment of the present invention;

Figure 2 is a sectioned side view of a projectile firing barrel according to the present invention;

Figure 3 is an end view of a projectile firing barrel according to the present invention.

DETAILED DESCRIPTION

Referring to Figure 1, there is shown an inflator 10 according to a preferred constructed embodiment of the present invention. Inflator 10 is operable to supply gas to rapidly inflate an airbag (not shown) for cushioning a vehicle occupant in the event of a crash or sudden vehicle deceleration, in a manner well known in the art. All the component parts of inflator 10 are either readily commercially available or are formed from known materials and by known processes. Inflator 10 includes a first body portion 12, preferably a substantially cylindrical hollow metallic tube, and a second body portion 32 that comprises a pressurized gas canister or bottle, also preferably substantially cylindrical. Canister 32 can be any of many known pressurized gas canisters, all commercially available. A connector 34, also preferably substantially cylindrical, and having an inwardly extending wall is preferably positioned between body portions 12 and 32, and preferably friction welded to the respective portions, via a process well known in the art. It should be appreciated that embodiments are contemplated wherein first body portion 12 is attached directly to second portion 32, rather than utilizing a connector therebetween. The various components 12, 32, and 34 can be assembled in any order and attached in any fashion, such as any type of weld, threads, press fitting, etc. A partition or nozzle sealing member 36 preferably separates the pressurized interior of canister 32 from an interior 13 of first body portion 12. In a preferred embodiment, partition 36 is laser welded to connector 34, however, it should be appreciated that some other connection means might be employed without departing from the scope of the present invention. Moreover, those skilled in the art will appreciate that because the present invention is applicable to a variety of pressurized gas canisters, the

shape of the canister attached to connector 12, and the manner in which it is sealed might vary significantly from the illustrated version in Figure 2.

A firing barrel 20 is positioned within first body portion 12, and preferably comprises a flange 21 and tube 22. Firing barrel 20 is preferably formed by deep draw stamping, or another suitable known process. Firing barrel 20 is preferably press fit into body portion 12, abutting a ledge 35, although it might be welded thereto or attached by some other means such as by threaded engagement.

Referring now to Figures 2 and 3, there are shown side and end views, respectively, of firing barrel 20. Flange 21 preferably includes a plurality of apertures 26, radially arranged around tube 22. In Figure 1, tube 22 is illustrated as cylindrical in cross-section, however, it should be appreciated that it might be constructed having other shapes without departing from the scope of the present invention. Returning to Figure 1, a projectile 50 is positioned in tube 22 of firing barrel 20, and is preferably positioned adjacent a pyrotechnic charge 24. Projectile 50 is preferably metallic and includes a pointed or otherwise sharpened end 51, however, different configurations and materials might be utilized without departing from the scope of the present invention. Pyrotechnic charge 24 may be any known gas generator booster propellant, preferably cured *in situ.* U.S. Publication No. 2002-0079680-A1 incorporated herein by reference describes an exemplary process. Gas generant 24 is positioned within tube 22 and is preferably ignitable via a touch hole 26 that connects an interior of tube 22 with interior space 13 of first body portion 12. Embodiments are contemplated in which the gas generant, preferably in tablet form, is placed within a container or metallic mesh filter in barrel 20.

An initiator assembly 14 is preferably positioned in a body bore 15 in the side of first body portion 12. In a preferred embodiment, initiator assembly 14 comprises an igniter or squib 16, any known suitable igniter, and a retainer 18. Initiator assembly 14 is preferably retained in bore 15 with a weld, for instance a resistance weld, and positioned such that igniter 16 extends into an interior 13 of first body portion 12. It should be appreciated that rather than welding initiator assembly 14 in bore 15, it might be press fit in place or secured by an adhesive or some other means. Igniter 16 is preferably connected to a vehicle electrical activation system in a conventional manner, allowing inflator 10 to be activated in response to a signal from an onboard computer.

In a preferred embodiment, activation of igniter 16 ignites propellant placed in igniter 16 itself or positioned nearby in space 13. Ignition of the propellant creates a flame front that traverses or fluidly communicates with touch hole 26 to ignite the booster propellant 24 in tube 22. Upon activation of gas generant 24, the rapid generation of gas in tube 22 supplies a force that drives projectile 50 through tube 22 toward partition 36. Partition 36 is preferably formed from a relatively thin metallic material capable of being punctured by projectile 50. The pointed end 51 of projectile 50 pierces partition 36, thereby establishing fluid communications between the interior of canister 32 and the interior 13 of body portion 12 via an aperture 38 in connector 34 and the apertures in flange 21. Consequently, pressurized gas for inflation of an associated airbag is supplied from canister 32. In a preferred embodiment, inflation apertures (not shown) in body portion 12 fluidly connect space 13 with an interior of an airbag. Various filters, burst shims, output enhancers, etc., all known in the art may be positioned in the path of the exiting inflation gas as desired. In addition, a wide variety of aperture patterns and means for dispersing the inflation gas might be formed integrally with body portion 12.

The present invention further provides an integral flange trap for capturing the spent projectile 50 after inflator activation. After projectile 50 is driven into and ruptures partition 36, the projectile is preferably positively retained in the space between flange 21 and connector 34.

In one embodiment, flange 21 is keyed relative to body portion 12, allowing insertion therein in a single orientation. In such an embodiment, flange 21 is preferably shaped relative to tube 22 such that upon insertion in body portion 12, touch hole 26 is oriented toward igniter 16. This feature facilitates proper positioning of barrel 20, in turn facilitating ignition of gas generant 24 by positioning touch hole 26 proximate igniter 16, allowing the flame front from activation of igniter 16 to reach gas generant 24 relatively easily. Flange 21 might be formed, for instance, having a non-circular periphery, allowing engagement with body portion 12 in only one, desired orientation. Alternatively, in an embodiment utilizing a threaded engagement between barrel 20 and body portion 12, the components may be threaded such that touch hole 26 is aligned with igniter 16 when barrel 20 is fully screwed into body portion 12.

By positioning initiator assembly 14 in the side of inflator 10 in bore 15, and utilizing a resistance weld, the present invention allows the inflator to be manufactured without a weld joint between the initiator housing and an end of the tube. Moreover, the present invention uses fewer parts than earlier designs, and positively captures the spent projectile. Finally, the design is relatively low cost, simple to assemble, and more reliable in operation than earlier designs.

It should be understood that the present description is for illustrative purposes only, and should not be construed to limit the scope of the present invention in any way. Thus, those skilled in the art will appreciate that various modifications might be made to the presently disclosed embodiments without departing from the scope of the present invention as described above and in the appended claims.